

THE SINKING FLOOR

Jim Smith felt that he had been picked as the fall guy. As a Soil Engineer, he had been consulted when Black & Associates had designed a building for Universal Packaging. When the President of Universal Packaging noticed the floor of his office was tilting and sinking, Jim was called by Black & Associates to discuss the problem. This case shows the background of the problem, Bill's efforts to retain the goodwill of his clients without admitting any liability and the eventual outcome.

THE SINKING FLOOR (A)

"Hell, that hasn't anything to do with us," Jim Smith exploded to himself as he hung up the phone. Bill Jensen, in-house structural consultant, of the A/E firm of Black and Associates, had just finished telling him that all hell was breaking loose around their place. The President of Universal Packaging had noticed that his office floor was beginning to sink and tilt. He had been chewing out Bill's boss, Dan Black. Bill had just suggested to Jim that they get together and go over the job.

As he sat at his desk Jim began to review in his mind what he could remember about the project: - about 3-1/2 years ago Bill Jensen had sent to Jim's company, Smith Laboratories, a work order to do a sub-soil investigation for a new office addition to the Universal Packaging building. The building addition was to be located in a part of town which everybody (who was familiar with the geological history of Carsonville) knew was an old alluvial valley overlain with soft saturated silty clays.

Jensen had told Jim (at the time the investigative work was to start) that they would probably need to support the building on piles. What the design firm needed primarily, he had said, was the depth to a stratum where piles could achieve a reasonable bearing capacity. They weren't sure whether the building would be 2 stories or 9 stories in height at that time. It had been decided that Jim's people would first drill and sample at a location in the center of the proposed building site. After the information from this boring was available and it had been discussed with Jensen, they would play it by ear and flesh out the investigation as conditions seemed to require.

Jim recalled somehow from memory that the first boring had been pretty much what was expected. The top 53 feet or so had been soft and weak and then fine sand was encountered. The "N" (1) values had started out fairly low in the sand, about 10 to 15 blows per foot. Both the "N" value and the grain size of the sand increased steadily with depth until at about 70 feet the "N" values were above 50. At 100 feet the standard penetration test had indicated essential refusal. Jim had assumed at the time that they had encountered bed-rock or shale at that depth. He and Bill Jensen had talked it over and decided that they would drill two additional holes and core drill one of them for about five feet to confirm the rock theory.

Jim got up from his desk and went to the company sub-soil investigations library and found the actual investigation logs and report. The boring location plan and soil profile (see Exhibit A & B)

-2-

showed that the profile of the site was pretty uniform with a soft Shaley Limestone deposit below the Glacial Till based on the single AX (2) core sample. The rock level had been erratic and undependable. The report which Jim himself had written at the time had indicated that the building loads anticipated would require foundation elements founded either in the dense sand or in the Glacial Till. He had written that economy would dictate the type of piles to be used. Timber, precast concrete, H-Beams, intrusion grouted or several mandrel driven piles could be used. Timber, however, probably wouldn't be used if they decided to build a nine story building.

Jim recalled as he studied the report that Bill Jensen had been satisfied with the information because it gave him what they needed. They would probably support the structure on piles driven into the dense sand, Bill had said.

Some months after the report had been filed, Jim had been invited to appear at the site. The General Contractor, Jackson Construction, was going to drive some test piles so that they could closely determine the pile length needed for the job. Although there wasn't any way to get paid for such appearances Jim had gone because Bill Jensen's firm had been giving his firm a considerable amount of sub-soil investigation work and he wanted to keep on good terms with Bill.

That day that the test piles were driven was Jim's first inkling that treated timber piles had been selected and the building would be two stories. Based on the boring report, they, (Black and Associates) hoped that a bearing of 30 tons per pile could be achieved at a tip of pile depth of 70 feet or less. Others who had gathered at the site for the test pile demonstration were Bill Jensen, Al Class and Jim Strunk. Al Class was the Structural Engineer making the structural design calculations and Jim was a Rodman on a survey crew for Black and Associates. Jim Strunk was to be the Inspector for both the test piles and the other piles when they were installed. He had never seen a pile driven before. However, since the job was apparently considered by many to be more of a bookkeeping job than an inspection job, it didn't seem to matter.

The contractor, using a double acting Diesel hammer, had proceeded to drive five piles at random locations but located where they could be

- (1): Blows per foot driving a two inch split spoon sampler using a 140 lb. wt. dropping 30 inches.
- (2): 1-1/2 rock core barrel

-3-

used in the foundation plan for the structure. In each case as the pile tip reached about 65 feet a bearing value had been calculated using the Blow Count (3) and a modified ENR (4) equation. (Modified by the Department of Roads at an earlier date for a bridge job on which Jackson Construction had used the same hammer). These calculations had indicated a bearing exceeding 30 tons including a safety factor of 3. Jim recalled all of this. In addition he remembered that the building perimeter loads and column were all the loads that were to be supported with these piles. No rationale about the structural design, height, loads on piles or selection of timber was mentioned to Jim that day or ever. He assumed that he had been invited so that he would be handy in case something unusual had occurred. As he had left the site that day he had felt grateful that the test piles had reacted in a manner that confirmed the soils data - at least using the modified ENR formula. He had known then and had thought many times that there wasn't much sacred about dynamic pile driving equations, especially the ENR equation. Full scale load tests on piles or pile groups would be preferable but were rarely if ever used. Jim had pursued this line of thought many times and had rationalized that people wouldn't spend money on load tests as long as the local pile driving record using dynamic equations hadn't resulted in an expensive failure. It could have been partly luck, partly safety factors or partly some other factors. At any rate, by the time he had returned to his desk that day, Jim had put the project out of his mind. He didn't consciously think about it again until Bill Jensen's recent phone call.

A meeting the day after the phone call at Bill Jensen's office included Al Class in addition to Jim and Bill. Bill described the situation in detail. Everything structurally seemed to be in good shape except the first floor where Universal Packaging President Jim Veach's office was located. Recently Mr. Veach had noticed light coming through at the top of the interior partition walls of his office. He had done a quick examination and gotten excited about the conditions because it certainly didn't look good for his very swank office and the other executive offices around him. He had called Dan Black who had put Bill Jensen on the case.

During the meeting Al Class explained the structural system. Essentially the perimeter piles and interior column piles supported the

(3): Penetration in inches for the last ten blows of the pile hammer.

(4): Engineering News Record. $B = \frac{2 \times E}{S + 0.1}$, E = Rated Energy (Ft.lbs.)
S = Set = 0.1" pile set per blow

-4-

reinforced concrete framework. The floor above the first was a structural slab, using precast prestressed double T's with a topping. He said the first floor was placed on fill and was not a structural slab. Fill of about six feet above natural ground and supporting the slab had been required due to a dock height and fallout shelter consideration in the rear of the building. As he was explaining the system and the first floor placement, he said, "Jim, you recall my asking you on the phone how much fill we could put in over the natural ground without having a settlement problem?" As he asked the question Jim felt as though a dark cloud had come over the meeting. Not only did he not remember such a question, but he knew what his answer would have been if asked - very little if any. Jim's 15 years of experience as a Registered Professional Engineer dealing with soils in the area had given him a great deal of confidence in dealing with almost every type of question on soils. Thoughts raced through his mind as he quickly focused on the situation - Black and Associates had a very disgruntled client. They needed an out. Who better to blame than Smith Laboratories? Someone at Black and Associates had made a bad error and they didn't have anything in writing to get them off the hook. Al Class was probably the man who had made the error. Repair, or bringing the settlement to a halt now could be both difficult and expensive. Six feet of fill over the soft alluvial soils below could allow settlement of the first floor to continue for some time. Jim made a quick mental decision - no way could his company take any responsibility beyond the original report. Al's question made it look like he had been picked as a fall guy. Unless a miraculous cure for the sinking floor could be devised it would probably mean the end of work for or through Black and Associates. It could even mean a lawsuit and the high expenses associated with most lawsuits.

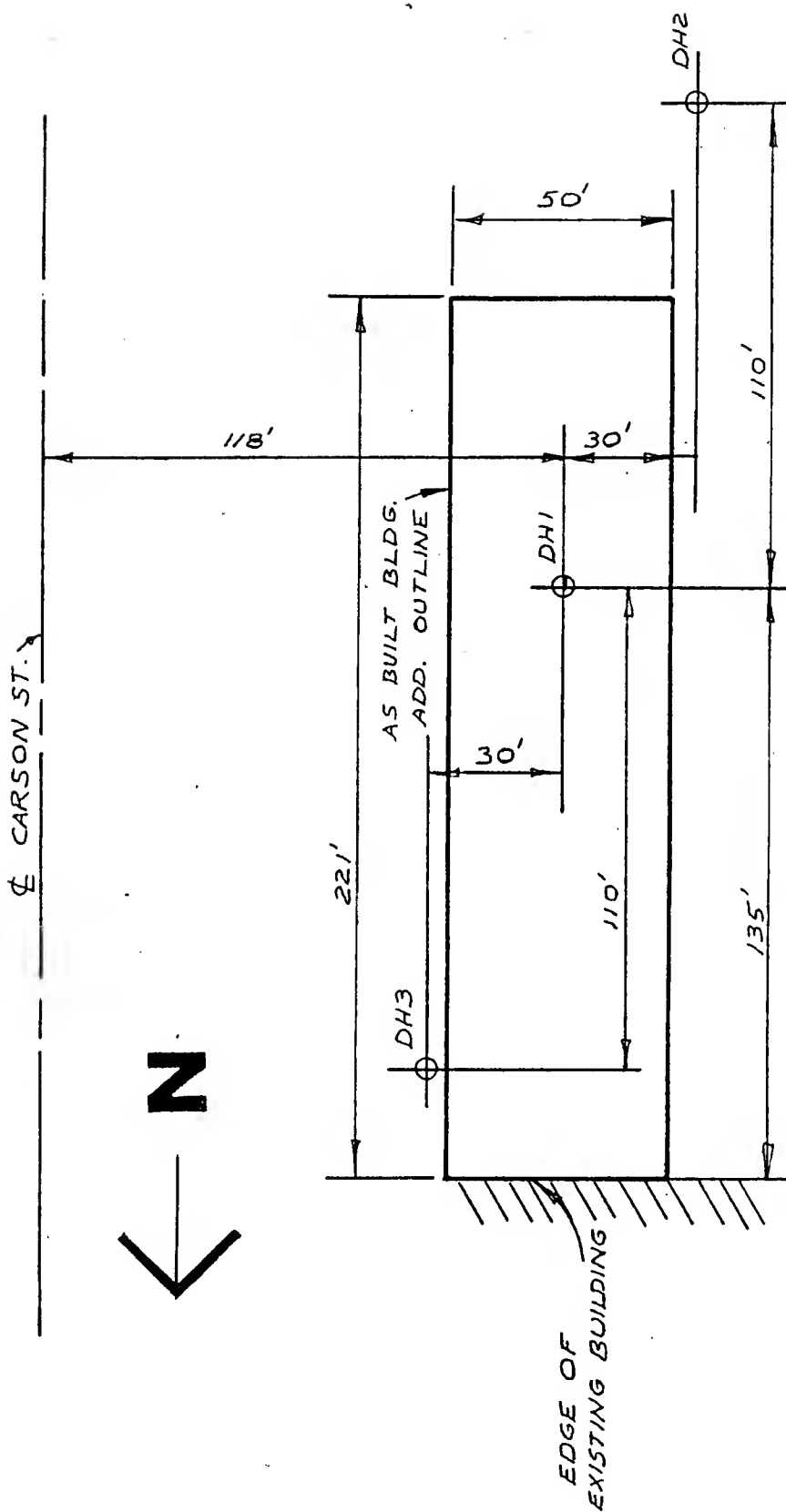


EXHIBIT A

SMITH LABORATORIES

BORING LOCATION PLANBUILDING ADDITION
UNIVERSAL PACKAGING

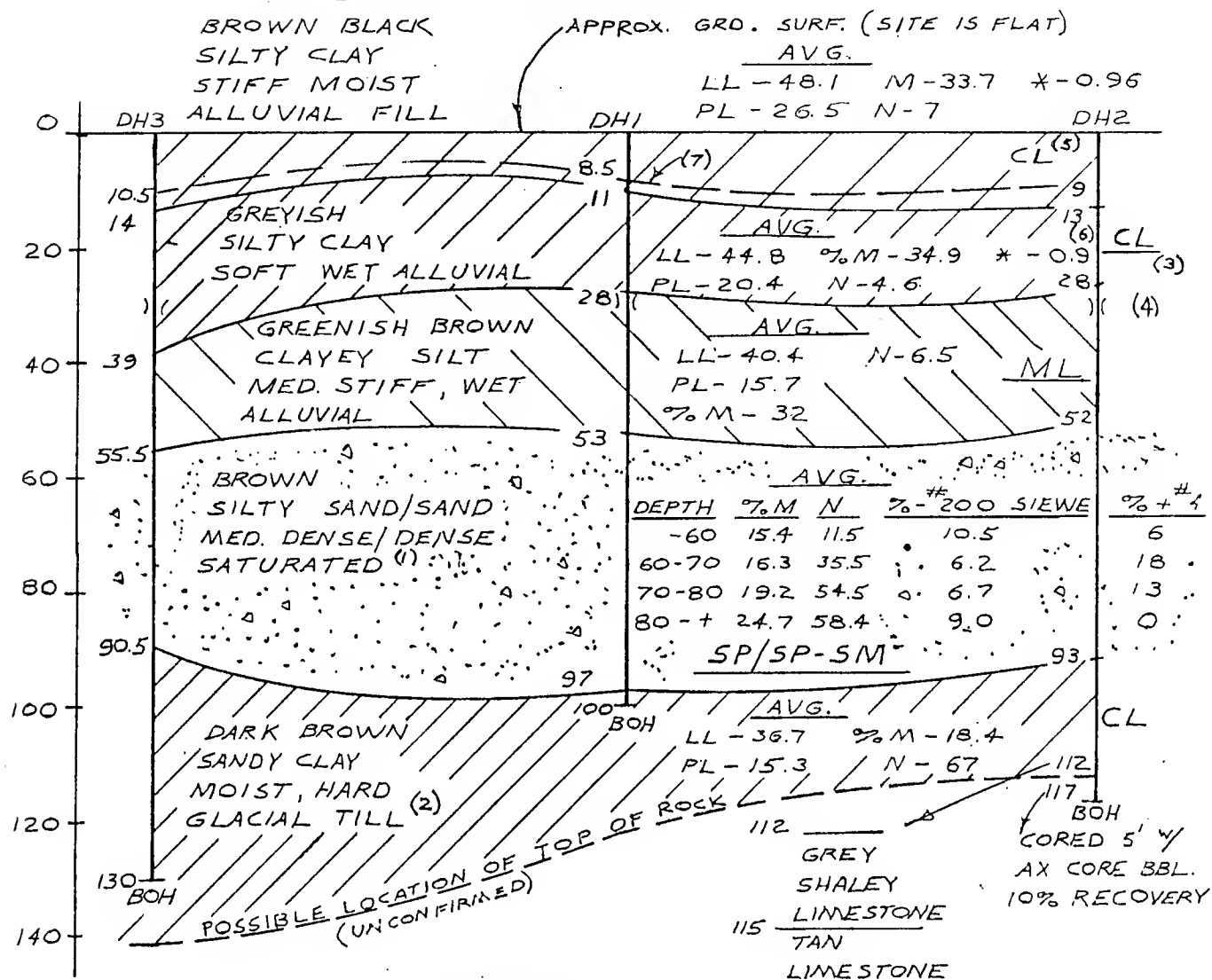
700 S. CARLSON DEC., 1960

NOTES

	DH1	DH2	DH3
DATE START	10/17/60	11/18	11/28
DATE FINISH	10/20/60	11/25	12/1
DEPTH	100'	117'	130'

EXHIBIT B

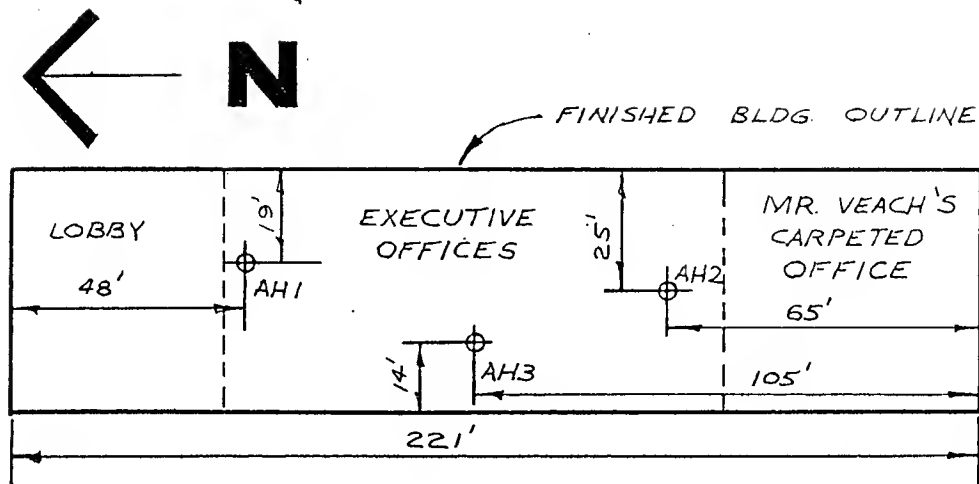
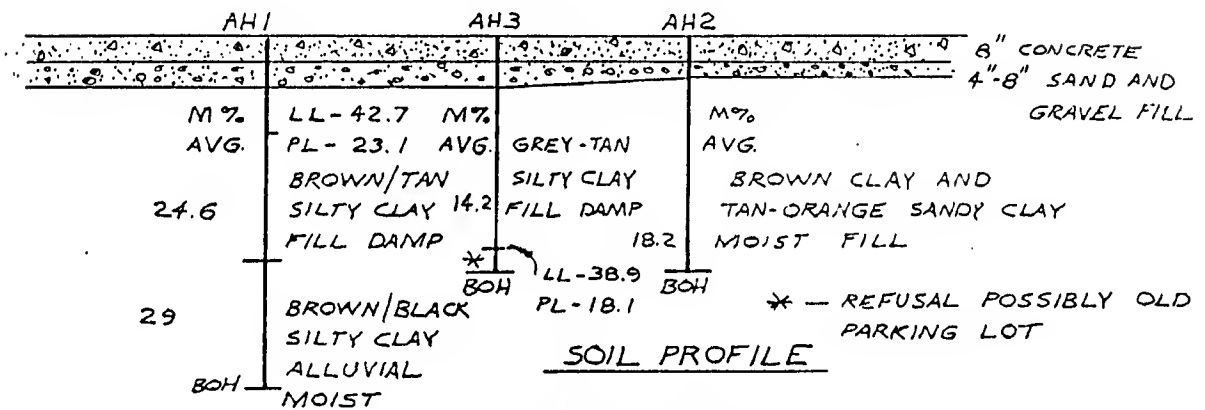
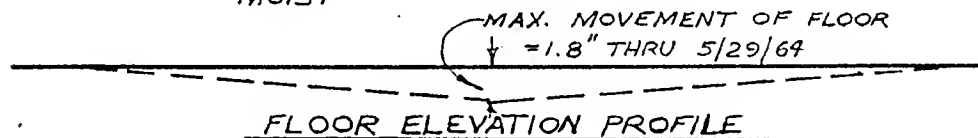
SOIL PROFILE



NOTES

- (1) BENTONITE USED TO STABILIZE (6) * = EST. U.C. TEST USING
POCKET PENETROMETER IN
TONS/SF. (AVG. IN 4.5" UN -
DISTURBED SAMPLES)
(2) SOME SAND LENSES
(3) APPROX. LAYER LINES
(4) HOLES SQUEEZING IN AT 32' ± (7) WATER TABLE 48 HOURS AFTER
HOLE DRILLED
(5) UNIFIED CLASS. SYSTEM

SMITH LABORATORIES
BORING LOCATION PLAN
BUILDING ADDITION
UNIVERSAL PACKAGING
700 S. CARLSON DEC., 1960

EXHIBIT CBORING LOCATION PLANSOIL PROFILENOTES

1. NO VOIDS UNDER CONCRETE FLOOR
2. AH1 DRILLED MUCH EASIER W/ THE HAND AUGER THAN AH2 AND AH3
3. SOIL FILL IN 2 AND 3 MORE UNIFORM THAN IN 1. AND LOWER MOIST. %

SMITH LABORATORIES

BORING LOCATION PLAN

AND

SOIL PROFILE

OF

EXISTING OFFICE ADDITION

UNIVERSAL PACKAGING

700 S. CARLSON

MAY, 1964

THE SINKING FLOOR (B)

Jim replied to Al Class' question, "I think I see what you have in mind, but, no, I don't recall any such question." Turning to Bill he said, "Bill, I think you know me well enough from past jobs that I wouldn't recommend putting an outhouse on that soil without piles and I certainly wouldn't tell Al to put six feet of fill in there and put a non-structural slab on it without anticipating a settlement problem." He went on to sum up his situation - "No, Smith Labs won't assume any part of the blame nor help pay for any remedial action."

He had never seen the plans and had not been consulted in any way since the test piles were driven. This was the usual method around Carsonville; seldom was the Soils Engineer consulted after the investigation report was delivered--unless something went wrong. The something, when it did come up, was something over which he had no control.

Bill, looking rather pained, indicated that a solution must be found. He inferred that if it were a question of whether or not to go along with Jim or Al, he had no choice. With the situation very murky and at least temporarily unresolved, Bill suggested a visit to the site to see what the actual conditions were. It was scheduled for the following day.

Jim returned to his office and explained the entire problem to George Spek, the Smith Lab's Chief Soils Engineer. George's reaction was precisely what Jim's had been - it isn't our problem. A review of the income record showed that about 15% of Smith Lab's income in the last year had been as a result of Black and Associates and Bill Jensen. Jim and George decided to go to the site the next day and hope that the settlement hadn't been too bad and that it had stopped.

After inspecting the sinking floor, the next day, and against George's wishes, Jim ordered a series of elevations to be taken of points on the first floor of the building referenced to a good Bench Mark. He scheduled a check of these points each month for several months to try and establish whether settlement of the floor was continuing and at what rate. In addition, his offer to core through the floor and sample the fill soils in several places had been accepted by Bill Jensen. George's argument against this action was that it was not up to them (Smith Lab). Jim's hope was that the checking and sampling would show a sincere desire to help solve the problem. He hated the thought of losing a good client so he would go the last mile in hope that it would work out somehow.

When the elevations were plotted they revealed slight but continuing settlement of the floor where it was supported only on the soil fill. Cracking was occurring. The coring and soil sampling didn't reveal anything startling. No voids under the floor were found. (See Exhibit C). Meantime, Mr. Veach had been putting continuous pressure on Mr. Black to take corrective action and it was passed along to Bill Jensen. Another meeting (including Bill, Al, Jim, and George) was held to review all of the information. All agreed it was a bad situation and getting worse. One piece of new information was offered by Al. When the fill was being placed by the contractor, he (Jackson) had had one in-place soil density test taken to prove he was meeting the compaction requirements of the spaces. Al said the result of 96% of the ASTM (5) standard seemed to indicate that the contractor did a good job. When questioned by George about one test representing this soil volume (about 4500 C.Y. in a 200'x100'x6' deep space) and about the type of soil used, compaction equipment, etc., he became vague and testy.

Jim felt that Bill was locked into an unsavory position. In view of the circumstances Jim had already mentally accepted the loss of a good client. He could not accept any idea of a financial contribution toward repair. Two feasible solutions had been mentioned. One was to live with it (settlement) until settlement ceased and then try a leveling process with concrete or other topping. The other was removing the present floor and rebuilding it as a structural slab, supported in some way by the existing piling system. In either case, the costs would be far beyond what a small company could contribute. He indicated this emphatically to Bill and Al with George's support.

As the meeting broke up Bill indicated that he hoped that there wouldn't be legal action that Smith Labs would be involved in. With that tidbit to think about during some sleepless nights Jim and George went back to the office to other work not knowing what the outcome would be.

Jim subsequently reviewed the case with the company attorney who seemed somewhat pessimistic. He reiterated his previous counsel: "Don't give any recommendations; do only the borings and tests without interpretation." A call to the company's insurance agent

(5): American Society for Testing and Materials. D698-66T. Moisture Density Relations of Soils, Using 5.5-lb rammer and 12-in. drop

reaffirmed that no errors-or-omissions-insurance was available for soil consulting even from Lloyds of London. Neither call was reassuring to Jim.

EPILOGUE

Bill Jensen transferred to Black and Associates' west coast office. Al Class left Black and Associates. Several years later he was on his third job since being employed at Black. Universal Packaging sold the building to a furniture company which still has the sinking floor but has it covered with floor samples. Smith Labs survived but was never retained for or through Black and Associates for any other work.

DISCUSSION QUESTIONS

1. Why would any one work as a Soils Engineer if the situation is so precarious? How could it be changed?
2. Other than what he did, what could Jim do?
3. What should Al Class have done if he were a true professional?
4. What about Bill Jensen? Dan Black?
5. Was there enough soils information for Al Class to work with in designing the structure?
6. Considering the use of the ENR equation, how much of a safety factor was actually involved?